

Course Title: Digital Signal Processing
Date: 17/1/2017 (First term)Course Code: CCE3116
Allowed time: 3 HoursYear: 3rd Comp.
No. of Pages: (2)Answer the following questions.Problem number (1) (15 Marks)

- (a) Check whether the following systems are static, linear, shift invariant, causal, and stable or not. (5 Marks)

(i) $y_1(n) = x(n^2 - 3)$

(ii) $y_2(n) = e^n x(n)$

Delay

static

Advance

causal

- (b) Consider the discrete-time sequence
- $x(n)$
- : (6 Marks)

$$x(n) = \{-2, -1, 0, 1, 2, 3\}$$

Sketch:

(i) $y_1(n) = x(-n)$

(ii) $y_2(n) = x(-n - 2)$

(iii) $y_3(n) = x(2 - n)$

- (c) Explain the basic elements of digital signal processing. (4 Marks)

Problem number (2) (16 Marks)

- (a) Find the inverse Z-Transform of the following functions: (12 Marks)

(i) $X(z) = \frac{z}{(z-0.5)^2(z-1)}$

(ii) $X(z) = \frac{z}{(z^2+1)} + \frac{3}{z+1}$

 $O(N^2)$
 $O(N \log N)$

- (b) Compare between the direct DFT method and the radix-2 DIT-FFT algorithm in terms of complex additions and complex multiplications. (4 Marks)

Problem number (3) (14 Marks)

- (a) Compute the linear convolution,
- $y(n) = x(n) * h(n)$
- , (7 Marks)

where $x(n) = \{1, 0, 1, -1\}$, $h(n) = \{1, 0.5\}$

- (b) Determine the 4-point DFT of the following sequence: (7 Marks)

$$x(n) = \{1, 0, -1, 2\}$$

Sketch the magnitude and phase of the result 4-point DFT.

Problem number (4) (25 Marks)

- (a) Using radix-2 algorithm, obtain the 8-point FFT-DIT of the following sequence

$$x(n) = \{1, 0, 0, 1, 1, 0, 0, 1\}$$

Follow exactly the corresponding signal flow graph and show all of the intermediate calculations on the graph. (9 Marks)

- (b) Compare between FIR filters and IIR filters. (3 Marks)

- (c) Consider the following filter transfer function, (6 Marks)

$$H(z) = \frac{(1 - Z^{-1} + Z^{-2})}{(1 - Z^{-1})(1 + Z^{-1} + 2Z^{-2})}$$

Draw

(i) Direct form I

(ii) Direct form II

(iii) Parallel form

- (d) Design a second order digital low pass filter with cutoff frequency of 250 Hz and sampling rate of 1000 Hz. (7 Marks)

Good luck

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$x(n)$	$X(z)$
$\delta(n)$	1
$(a)^n$	$\frac{z}{z - a}$
$u(n)$	$\frac{z}{z - 1}$
e^{-an}	$\frac{z}{z - e^{-a}}$
n	$\frac{z}{(z - 1)^2}$
$\sin(wn)$	$\frac{z \sin(w)}{z^2 - 2z \cos(w) + 1}$